

No. 804,996.

PATENTED NOV. 21, 1905.

R. A. ANTHONY.
TELESCOPY.

APPLICATION FILED MAR. 10, 1905.

3 SHEETS—SHEET 1.

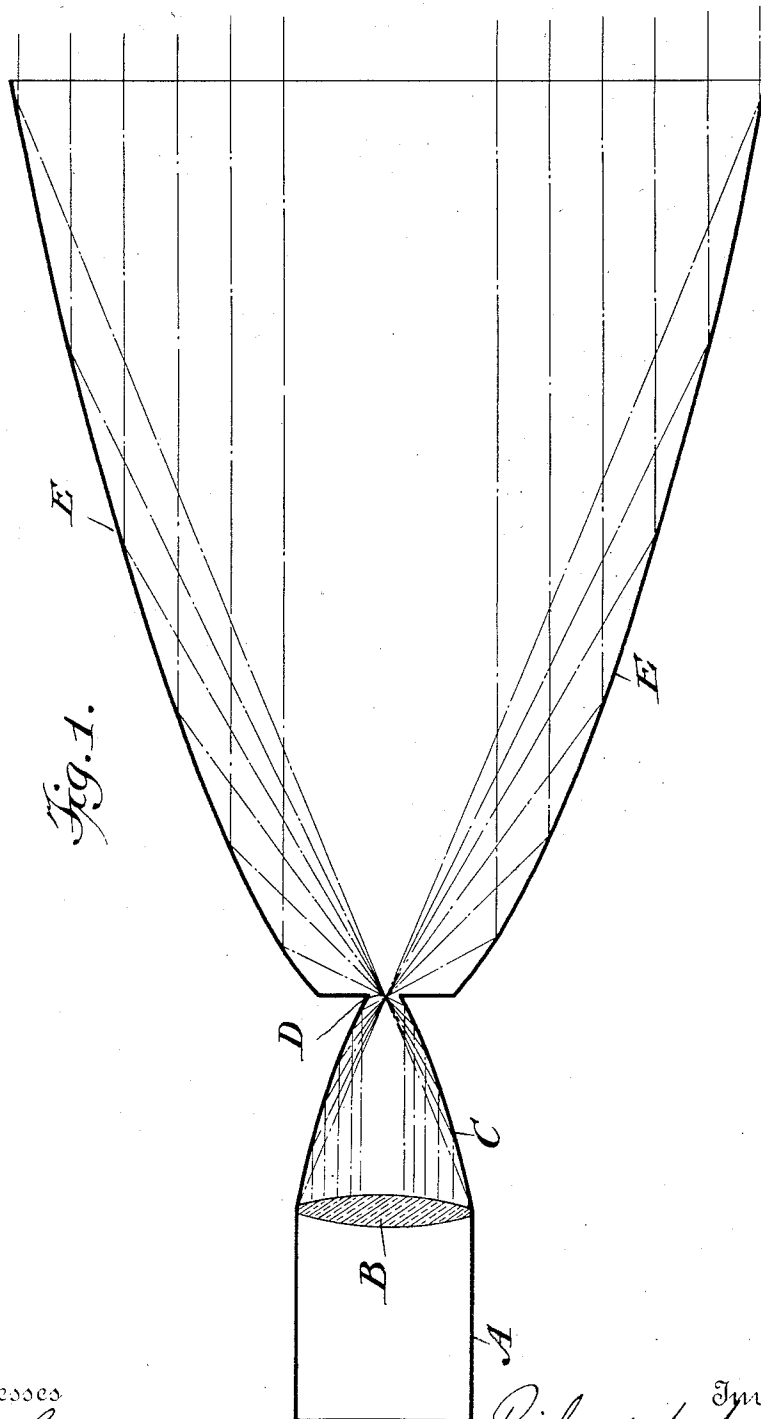


Fig. 1.

Witnesses
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Louis Kaganovitz

Inventor
Richard A. Anthony
By his Attorney *Phillips Abbott*

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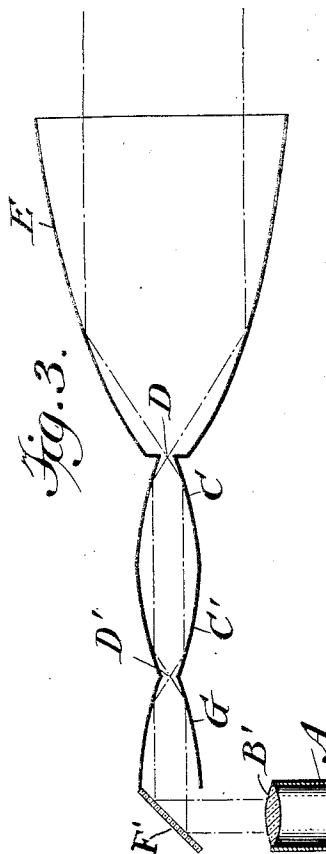
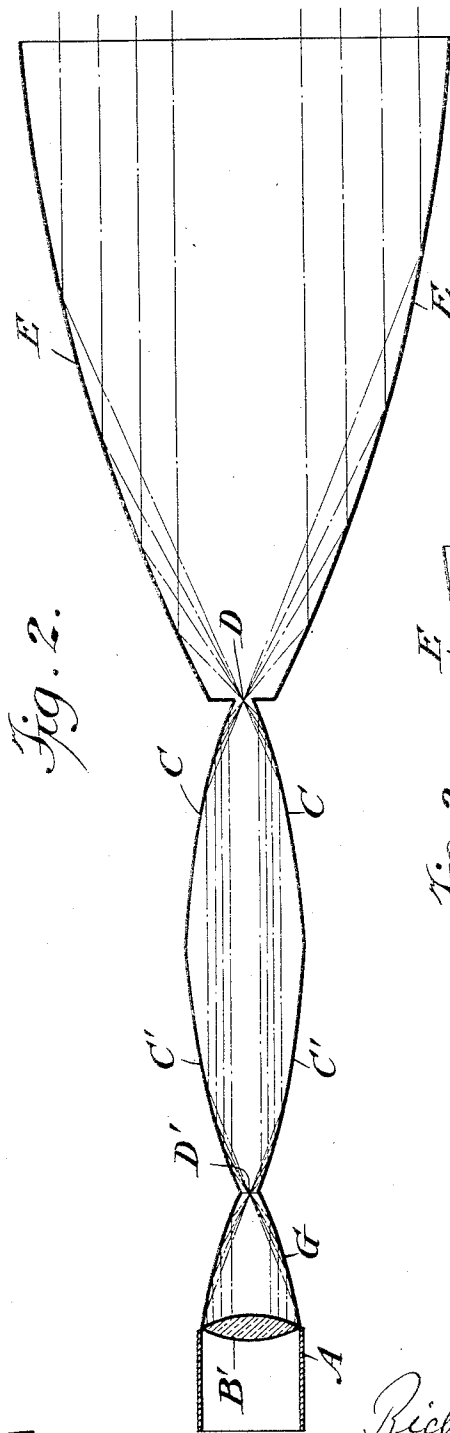
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3 SHEETS—SHEET 2.



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3 SHEETS—SHEET 3.

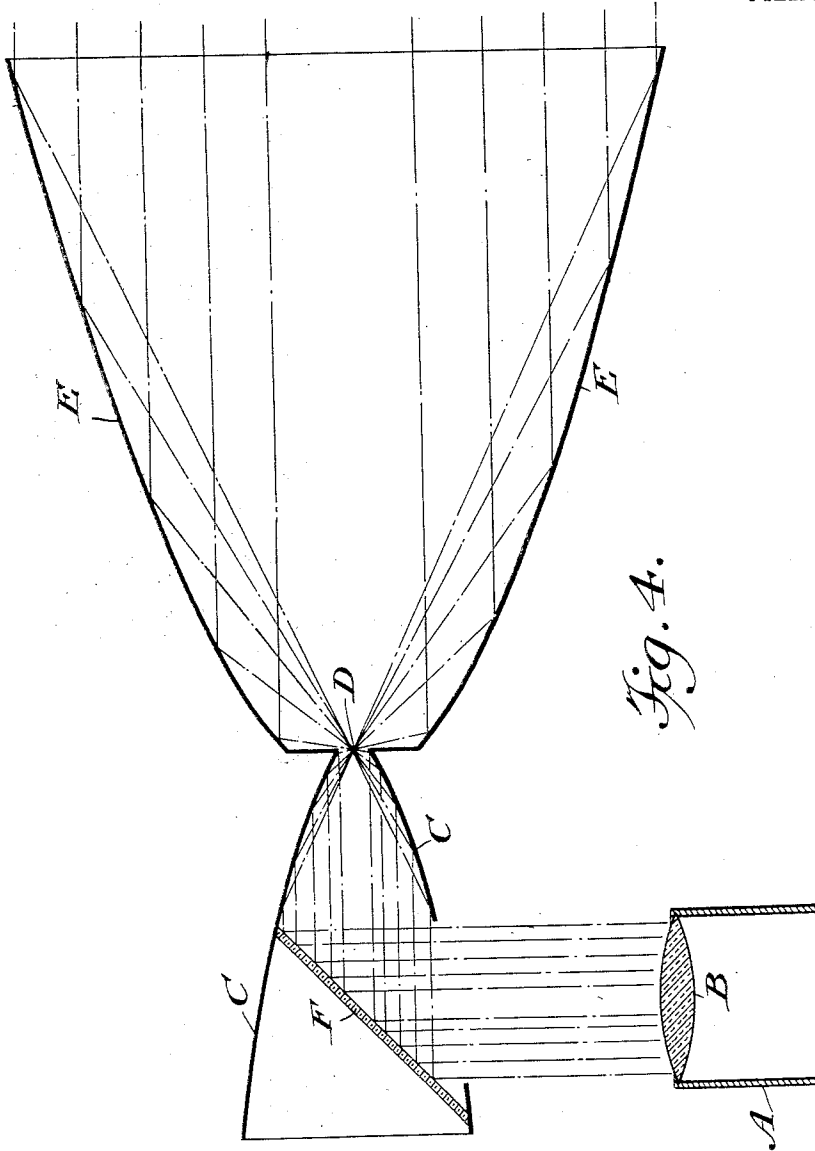


Fig. 4.

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UNITED STATES PATENT OFFICE.

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TELESCOPY.

No. 804,996.

Specification of Letters Patent.

Patented Nov. 21, 1905.

Application filed March 10, 1905. Serial No. 249,354.

To all whom it may concern:

Be it known that I, RICHARD A. ANTHONY, a citizen of the United States, and a resident in the borough of Manhattan, city, county, and State of New York, have made a new and useful Invention Applicable to Telescopy and Kindred Optical Arts, of which the following is a specification, reference being had to the accompanying drawings, in which—

Figure 1 illustrates a device embodying my invention in one of its forms and adapted to use in conjunction with an ordinary telescope. Fig. 2 illustrates apparatus likewise embodying the invention in a somewhat more elaborated form. Fig. 3 illustrates a modification of that which is shown in Fig. 2. Fig. 4 illustrates a modification of that which is shown in Fig. 1.

Heretofore in instruments of the classes stated all the light from the object or objects viewed entering the instrument has been that which could pass inwardly through a relatively small lens at the receiving or light-entering end of the apparatus, whatever it may be.

Under my present invention I utilize the laws governing the reflection of light from curved surface in the manner hereinafter explained, whereby I am enabled to collect and concentrate either upon a lens or a mirror, as the case may be, vastly more rays of light reflected from the body or bodies to be viewed than has heretofore been possible.

In this specification I shall describe my invention as applied to certain specific instruments or devices hereinafter to be described; but I wish it understood that the principles involved, with suitable mechanical changes, are adaptable to transits and other instruments.

I will first describe my apparatus as it is illustrated in Figs. 1 and 4, in which it is applied to telescopes, Fig. 4 being a modified construction and arrangement of the parts.

To the tube of an ordinary telescope A, provided with the usual object-glass B, I attach what I term a "projecting-reflector" C, which has the general interior outline or contour of a parabola, semi-ellipse, or, in some instances, a hyperbola. This reflector is cut off at or near its focal parameter D—in other words, at its focal plane—and to this a much larger exterior reflector E, which I call

the "receiving-reflector," is connected. It also is truncated or cut off at or near its parameter—in other words, on its focal plane—so that when combined these two reflectors constitute a single structure the foci of which are coincident and their axes are likewise coincident, while their larger openings face in diametrically opposite directions. The precise line on which the larger end of the receiving-reflector shall terminate is not necessarily fixed. It may be anywhere on the axis to the right of the focus.

The method of connecting the projecting-reflector C with the tube A may be such as preferred, or the two reflectors may be separately supported and brought into proper relation with the telescope and object-glass in any preferred manner. Also the outer or receiving reflector and the inner or projecting reflector need not necessarily be physically connected with each other. They may be merely brought into proper relative position.

The operation of the apparatus thus far described is as follows: The large opening of the receiving-reflector E being turned toward the object or objects to be viewed, the light emanating from them, owing to their distance, will enter the mouth of the receiving-reflector in substantially parallel lines or rays and striking its inner curved surface will under the laws governing the reflection of light in such cases be thrown directly into the focus of the receiving-reflector, and since this focus is likewise the focus of the projecting-reflector C the rays of light after crossing the foci will impinge on the inner curved surface of the projecting-reflector and again following the said laws will be projected therefrom, if it be a paraboloid, in lines parallel to the axis of the reflectors direct upon the object-glass of the telescope, which is placed at the larger end of the projecting-reflector, as shown.

It will be clear to those who are familiar with this subject that whereas under the old art the rays of light which entered the telescope were only those which impinged upon and passed through the object-glass in my improved construction I secure vastly better and more satisfactory results, because I am enabled to collect and pass through this same lens not the relatively limited number

of rays which fall directly upon it, but, on the contrary, all the rays which fall within the enlarged open mouth of the receiving-reflector, (except those that fall directly upon the parameter of the larger reflector and do not pass through into the projecting-reflector.) The number of such lost rays, however, is exceedingly small in comparison with the number which are collected, concentrated, and utilized under my invention. The area of the open mouth of the receiving-reflector may be practically without limit. Indeed, I contemplate making it many feet in diameter should occasion require.

Referring now to Fig. 4, in which the parts are or may be the same as above described, as a matter of convenience and for conservation of space instead of having the telescope-tube A and the object-glass B arranged on the axial line of the reflectors I arrange them at right angles thereto, and in order to secure rectangular deflection of the collected and concentrated rays I employ a mirror F at an angle of forty-five degrees to the axes of the reflectors, upon which mirror the projected rays will impinge and be deflected rectangularly, as shown.

Referring now to Figs. 2 and 3, it will be noted that when the apparatus illustrated in Fig. 1 is employed the position of the image is inverted, and although under certain circumstances this will be of no consequence, yet in other cases it will be objectionable. In order, therefore, that the image as reproduced may be in its actual or erect position, I sometimes construct and arrange the apparatus as illustrated in Figs. 2 and 3, in which the parts, so far as they have been above described, are correspondingly lettered—that is to say, E is the exterior or receiving reflector, D the focus thereof, C the projecting-reflector. To this reflector I connect at its open or rearmost end a counterpart reflector C', the focus of which is at D', and to this, still at the left, I connect or locate another projecting-reflector G, combined with which may be the object-glass B' of the telescope-tube A.

The operation of the apparatus shown in Fig. 2 is substantially the same as that shown in Fig. 1, excepting that owing to what I call the "secondary reflection of the light-rays" the object is reproduced at the object-glass in its erect instead of inverted position. The combined reflectors C and C' may be made in any preferred manner. I have shown them as made from two parabolic reflectors connected at their larger diameters, as shown in the drawings.

In Fig. 3 substantially the same construction is illustrated as that shown in Fig. 2, excepting that the reflecting-mirror F, substantially the same in function and method of operation as that shown in Fig. 4, may be used to secure rectangular projection of the

light-rays. This requires no further description.

It will at once be obvious, however, to those who are familiar with this art that a combination of lenses of such conformation as desired to accomplish any specific result or a single lens having such conformation as desired may be substituted. The construction I show is intended to be illustrative only. For the accomplishment of certain results, which need not here be discussed, it will be found desirable to give to the receiving-lens or object-glass the contour of a parabola, hyperbola, or semi-ellipse.

The laws governing the reflection of light-rays from parabolic, elliptical, and hyperbolic surfaces are well understood and do not require specific explanation here except to say that when the subject is at a great distance the receiving-reflector should preferably have parabolic contour, because the rays of light coming from such distances are, for all practical purposes, parallel, and hence impinging upon the inner surface of a parabolic receiver will be deflected directly to its focus, resulting in the advantages above explained. If, on the contrary, an object or objects relatively close at hand are to be viewed or reproduced, then the receiving-reflector might preferably have a parabolic or elliptical interior contour, because, although the rays of light, owing to the proximity of the subject, will not come in parallel lines, nevertheless the hyperbolic or elliptical receiver will collect and measurably, or at least to a large extent, concentrate them at the desired point.

It will be obvious to those who are familiar with this art that modifications may be made in the details of construction of the apparatus shown and described by me without departing from the essentials of the invention. I therefore do not limit myself to such details.

I claim—

1. The combination of a telescope-tube a receiving-reflector and a projecting-reflector, whose interior surfaces diverge in curved lines from their axes, both truncated at or near their respective focal planes, and having their foci and axes coincident, and a lens, for the purpose set forth.

2. The combination of a telescope-tube a receiving-reflector and a projecting-reflector, whose interior surfaces diverge in curved lines from their axes, both truncated at or near their respective focal planes, and having their foci and axes coincident, and a lens located in or near the projecting-reflector and adapted to receive the rays projected therefrom, for the purpose set forth.

3. The combination of a telescope-tube a receiving-reflector and a projecting-reflector, whose interior surfaces diverge in curved lines from their axes, both truncated at or near their respective focal planes, and hav-

ing their foci and axes coincident, a mirror arranged at an angle relative to the axis of the projecting-reflector and adapted to receive the rays projected therefrom and to deflect them, for the purpose set forth.

4. The combination of a telescope-tube a receiving-reflector and a projecting-reflector, whose interior surfaces diverge in curved lines from their axes, both truncated at or near their respective focal planes, and having their foci and axes coincident, a mirror arranged at an angle relative to the axis of the projecting-reflector and adapted to receive the rays projected therefrom and to deflect them, and a lens, for the purpose set forth.

5. The combination of a telescope-tube, a receiving-reflector for collecting and concentrating rays of light, the interior surface whereof diverges in curved lines from its axis, and which is truncated at or near its parameter or focal plane, whereby the rays of light received at its larger open end will be collected, concentrated and passed through the opening at its focus.

6. The combination of a telescope-tube a receiving-reflector, the interior surface whereof diverges in curved lines from its axis and which is truncated at or near its focal plane, and an ellipsoid, or double paraboloid reflector truncated at or near both foci, and a projecting-reflector, the interior surface whereof diverges in curved lines from its axis and which is truncated at or near its focus, all being suitably arranged with reference to their respective foci and having a common axial line, for the purpose set forth.

7. The combination of a telescope-tube a receiving-reflector, the interior surface whereof diverges in curved lines from its axis and which is truncated at or near its focal plane, an ellipsoid, or double paraboloid reflector truncated at or near both foci, a projecting-reflector, the interior surface whereof diverges in curved lines from its axis and

which is truncated at or near its focus, all being suitably arranged with reference to their respective foci and having a common axial line, and a lens combined with the projecting-reflector and adapted to receive the rays projected therefrom, for the purpose set forth.

8. The combination of a telescope-tube a receiving-reflector, the interior surface whereof diverges in curved lines from its axis and which is truncated at or near its focal plane, and an ellipsoid, or double paraboloid reflector truncated at or near both foci, and a projecting-reflector, the interior surface whereof diverges in curved lines from its axis and which is truncated at or near its focus, all being suitably arranged with reference to their foci and having a common axial line, and a mirror arranged at an angle relative to the axis of the projecting-reflector and adapted to receive the rays projected therefrom and to deflect them, for the purpose set forth.

9. The combination of a telescope-tube a receiving-reflector, the interior surface whereof diverges in curved lines from its axis and which is truncated at or near its focal plane, an ellipsoid, or double paraboloid reflector truncated at or near both foci, and a projecting-reflector, the interior surface whereof diverges in curved lines from its axis and which is truncated at or near its focus, all being suitably arranged with reference to their foci and having a common axial line, a mirror arranged at an angle relative to the axis of the projecting-reflector and adapted to receive the rays projected therefrom and to deflect them, and a lens, for the purpose set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

RICHARD A. ANTHONY.

Witnesses:

PHILLIPS ABBOTT,
F. M. DONSBACH.